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Forest Pest Management

BIOLOGICAL
EVALUATION R2-75-30
REVISED

PONDEROSA PINE
PROVENANCE PLANTING

HORNING STATE FARM
PLATTSMOUTH, NEBRASKA

August 1975

Rocky Mountain Region

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INTRODUCTION

Tip moths of the genus Rhyacionia infest pines throughout the Great Plains causing widespread deformity of pine plantations, Christmas tree stock and shelterbelt plantings. Plantings from the seedling stage to 12 feet tall appear to be particularly susceptible to attack. Hosts include ponderosa pine, Pinus ponderosa Laws, Scotch pine, P. sylvestris L., and Austrian pine, P. nigia Arnold. Damage is caused by tip moth larvae which feed on inner tissues of needle fascicles, buds, and shoots.

A ponderosa pine plantation on the University of Nebraska's Horning State Farm, south of Plattsmouth, Nebraska, was found to be infested for the first time in June, 1975. Tip moth was not found on the State Farm prior to this observation. This plantation, established in 1968, consists of ponderosa pine from 50 geographically different seed sources. It is currently used by the Rocky Mountain Forest and Range Experiment Station for resistance studies of ponderosa pine to the dothistroma needle blight, Dothistroma pini Hulb. At the request of the Rocky Mountain Station, a damage survey was conducted on August 25-28, 1975 to determine: 1) percent infested tips for the entire planting; and 2) percent infested tips by seed source to supplement on-going pine tip moth resistance investigations in the Great Plains.

TECHNICAL INFORMATION

Causal Agent: The genus Rhyacionia (Lepidoptera: Olethreutidae) is currently undergoing a revision, and species determination is quite difficult at the present time. Pupae were observed within branch tips, indicating that the species is R. frustrana (Comst.), the Nantucket pine tip moth. Other species that may be present include the western pine tip moth, R. bushnelli (Busck) and the southwestern pine tip moth, R. neomexicana (Dyar).

Type of Damage: Light to moderate shoot damage causing growth loss and tree deformity.

Life History: Life histories vary, depending on the species present. Generally, in Nebraska, there are two generations per year. First generation adults emerge in mid-spring, and second-generation adults in mid-summer. Eggs are laid several days after adult emergence on needles, buds, or shoots, and hatch in one- to two weeks. Larvae bore into and feed on the inner tissues of needles, buds, and shoots. Pupation may occur in shoots or in the soil duff beneath the infested tree. The insects overwinter in the pupal stage.

METHODS

The plantation consists of ponderosa pine trees from 50-seed origins, planted in 10-tree plots, replicated 6 times, for a total of 3,000 trees. The total number of damaged and undamaged shoots were counted on 2 trees from each plot, in 3- of the 6 replications. A total of 300 trees were sampled--6 from each seed origin. Height of each sample tree was estimated to the nearest foot. No distinction was made between shoots damaged by first- or second-generation larvae. Tip moths were either late larvae or pupae of the second generation at the time of sampling.

RESULTS AND DISCUSSION

Tip moth damage was light to moderate in the plantation. Damage ranged from a mean of 9.3 percent of the shoots from the Ainsworth, Nebraska (#720) seed source, to a mean of 51.5 percent of the Colorado Springs, Colorado (#860) seed source (Appendix A). Over-all damage, for all seed sources, averaged 25 percent for the 300 trees sampled.

A two-way analysis of variance (Table 1) of the percent infestation of each tree shows significant difference between seed origins and between replications at the .001 level. Interaction effect between seed origin and replication was also significant at the .001 level.

TABLE 1
ANALYSIS OF VARIANCE OF SEED ORIGIN
SUSCEPTIBILITY TO TIP MOTH

Source of Variation	df	SS	MS	F
Seed Origin	49	24902	508	4.90
Replication	2	5639	2819	27.19
Interaction	98	25390	259	2.50
Error	150	15553	103	

The variation between replications can be related to the physical arrangement of the plantation and the distribution of the tip moth population within the plantation. The trees were planted in 6 replications, each having 10 trees from each of the 50-seed origins. The replications ran along the side of a hill. Samples were taken from replications 1, 3, and 6, with replication 1 being near the top of the hill, and replication 6 at the bottom of the hill. The mean percent infestation for the 3 sampled replications were: replication 1, 37%; replication 3, 35%; replication 6, 27%. This shows that the tip moth infestation was more intense in the replications near the top of the hill than those at the bottom.

Since each origin was planted in each row, and the row effect was accounted for in the analysis of variance, the high level of significance demonstrates definite differences in susceptibility to tip moth between seed origins. All origins were ranked by mean percentage infestation (Appendix A). The error sum of squares from the analysis of variance was used to calculate a standard error of the mean. This was used to calculate a value for comparing significant differences between means, using Tukey's procedure (Steel and Torrie, 1960). The calculated value is 5.59. Therefore, the difference between any two means ranked in Appendix A can be considered significant at the .05 level if it exceeds 5.59. With 50-seed origins ranging in percent infestation from 9.3 to 51.5, there are many significant differences between origins. The seed origins that are of greatest interest are those that lie at the extremes of susceptability and resistance. By looking at Appendix A, it can be seen that seed origins 720, 856, and 721 are all significantly less susceptible to tip moth than all other origins. Conversely, origins such as 860, 859, and 766 are quite susceptible and do not compare favorably with most of the other origins.

Correlation of tree height to percent infestation for the 300 trees was tested. Shorter trees had a higher percent infestation. Although this relationship is statistically significant, the correlation is extremely variable and is not useful for relating infestation rate to tree height.

CONCLUSIONS

Tip moth damage occurred to 25 percent of the shoots on the trees sampled in 1975. Seed sources from Ainsworth, Nebraska (#720); Arnold, Wyoming (#856); and Valentine, Nebraska (#721) appear relatively resistant to tip moth; while seed sources from Colorado Springs (#860), and Franktown (#859), Colorado, and Ruidoso, New Mexico (#766), appear to be particularly susceptible.

Tip moth damage and tree deformity can be expected to continue next year on all seed sources. If the tip moth population is at a level considered by investigators to be interferring with on-going needle blight studies, insecticidal suppression efforts are a possibility. There are several insecticides that are currently registered for use against the Nantucket pine tip moth and western pine moth. Insecticidal treatments may be required annually for an indefinite time period to hold the tip moth population at an acceptable level until the plantings reach about 12 feet tall, when they become less susceptible to damage. Reinfestation from adjacent plantings in and around Horning State Farm may occur.

For safety and ease in handling, the foliar systemic spray Dimethoate, trade name Cygon 267 would be best. Sexson and Roselle (1974) obtained satisfactory control against the western pine tip moth which may also be present in the plantation. Six-year-old ponderosa pine test trees at North Platte, Nebraska sustained western pine tip moth damage to 16.2% of the shoots, and 9-year-old ponderosa pine to 8.0% of their shoots at Lincoln, Nebraska after treatment with Dimethoate 0.125% spray. Dimethoate should be applied so that tips and new foliage are completely drenched. Applications should be timed with the start of egg deposition - generally during the 3rd week of May and 1st week of July. They also state that effectiveness may be increased with 4 applications; 3rd week of May, 2nd week of June and 1st and 3rd weeks of July. Lindane, Parathion, and Disulfoton are also registered for use against the Nantucket pine tip moth. Disulfoton is a granular insecticide that must be incorporated into the soil. Extreme caution should be taken when applying Disulfoton and Parathion - we do not recommend their use.

Forest Pest Management will assist in monitoring the tip moth population and timing of insecticidal applications, if desired.

REFERENCES

Sexson, Gary D. and R. E. Roselle. Effectiveness of Systemic Insecticides Against the Pine Tip Moth of Ponderosa Pine. USDA - Forest Service Research Note RM-277, 5 pp. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado 1971.

Steel, R. G. D. and J. H. Torrie, 1960. Principles and Procedures of Statistics. McGraw-Hill, Inc., New York, 481 p.

The use of trade names is for the benefit of the reader; such use does not constitute an official endorsement or approval of any service or product by the U. S. Department of Agriculture to the inclusion of others that may be suitable.

APPENDIX A
TOTAL AVERAGE NUMBER OF SHOOTS;
AVERAGE PERCENT TIP DAMAGE; AND AVERAGE TREE HEIGHT
FOR SAMPLED TREES BY SEED SOURCE

Seed Source	Number	Mean No. Shoots	Mean Percent Damage	Mean Tree Height (Ft.)
Ainsworth, Nebr.	720	202.2	9.3	9.5
Arnold, Wyo.	856	231.5	11.9	8.5
Valentine, Nebraska	721	293.5	14.2	10.3
Colstrip, Mont.	824	296.7	21.4	9.8
Gardner, Colo.	764	224.0	22.8	9.8
Ft. Laramie, Wyo.	846	242.2	23.3	7.8
Potter, Nebr.	758	276.2	24.5	9.2
Recluse, Wyo.	832	329.8	24.5	9.8
Hamilton, Mont.	820	134.2	24.6	8.7
Dayton, Wyo.	829	253.3	25.3	8.8
Reva, S. D.	704	265.2	26.5	9.7
Buford, Wyo.	857	197.3	26.9	8.0
Jordan, Mont.	811	229.3	27.3	11.0
New Castle, Wyo.	835	272.5	27.5	10.3
Douglas, Wyo.	848	230.0	27.6	8.0
Buffalo, Wyo.	831	193.8	28.4	8.5
Helena, Mont.	816	235.2	28.6	9.2
Aladdin, Wyo.	833	275.8	29.1	9.8
Glendive, Mont.	826	346.8	29.2	10.7
White Clay, Nebr.	853	259.8	29.4	9.8
Ft. Union, N. Mex.	863	235.3	31.4	9.3
Allenspark, Colo.	760	219.2	31.9	7.3
Roundup, Mont.	822	254.8	32.6	11.7
Harrisburg, Nebr.	845	227.5	32.6	7.8
Hill City, S. D.	838	279.2	32.8	8.8
Mayhill, N. Mex.	767	219.7	33.5	8.8
Lewistown, Mont.	815	182.5	33.6	8.3
Martin, S. D.	854	263.5	33.9	9.2
Raton, N. Mex.	862	332.3	35.1	9.2
Woodland Park, Colo.	763	270.8	35.8	7.3
Darby, Mont.	819	68.2	36.0	9.0
Limon, Colo.	762	313.8	37.0	8.5
Hermosa, S. D.	840	245.5	37.5	9.2
Ft. Robinson, Nebr.	851	244.0	37.9	9.8
Zortman, Mont.	813	238.3	38.0	9.5
Scottsbluff, Nebr.	723	250.3	38.1	9.3
Gulnare, Colo.	765	323.5	38.8	10.3

APPENDIX A
(Continued)

Seed Source	Number	Mean No. Shoots	Mean Percent Damage	Mean Tree Height (Ft.)
Ft. Valley, Ariz.	869	264.0	39.0	9.2
Sundance, Wyo.	834	217.7	39.4	9.2
Queen, N. Mex.	768	226.0	40.1	9.5
Lead, S. D.	837	269.2	40.9	10.0
Rye, Colo.	861	278.7	42.1	9.2
Ekalaka, Mont.	827	236.0	43.1	8.8
Medora, N. D.	702	168.0	44.2	8.3
Shawnee, Wyo.	849	238.3	44.7	9.3
Las Vegas, N. Mex.	864	154.2	45.8	8.3
Rushville, Nebr.	852	244.3	46.7	9.0
Ruidoso, N. Mex.	766	264.8	47.2	8.7
Franktown, Colo.	859	258.7	48.1	8.5
Colo. Spgs., Colo.	860	188.3	51.5	7.3